

Optimised non-uniform biasing technique for a high-speed optical router to achieve uniform semiconductor optical amplifier gain

Abstract:

In this study, we propose applying non-uniform biasing current technique to improve the gain uniformity of the semiconductor optical amplifier (SOA) for high-speed optical routers. The output pulses will have high-gain deviation because of the high-speed input pulses and the slow SOA gain recovery, thus resulting in a high system power penalty. The theoretical SOA operation principle is demonstrated using a segmentation model that employs the rate and propagation equations with third-order gain coefficients. The impact of the bias current on the SOA gain responses owing to the input packet of 1 mW input Gaussian pulses at a wavelength of 1550 nm is analysed in order to optimise the proposed non-uniform bias current shape. The uniform and the optimised non-uniform bias current techniques are investigated in terms of the SOA gain uniformity and the average output power for high-speed data rates from 10 to 160 Gb/s. The impact of the average bias current applied to the SOA on the non-uniform shape is also investigated at all input data rates. Results obtained show a significant improvement in the gain standard deviation of 4.6, 6.3, 8.7, 10.1 and 10.2 dB for the data rates of 10, 20, 40, 80 and 160 Gb/s, respectively, when applying 150 mA average non-uniform biasing and these values reaches 15.2, 16.3, 17.7, 18 and 17.4 dB at 200 mA. The proposed technique also offers an increase in the average output power for the input pulses compared with uniform biasing.